

How much do I weight in Space?

Standards Statement:

3.1.7.E – Identify change as a variable in describing natural and physical systems.
3.4.7.D – Describe essential ideas about the composition of the universe and the earth's place in it.

National Standard:

- Knows the relationship between the strength of a force and its affect on an object.

Content Objective:

Students will be able to:

1. Explain the factors that determine gravity.
2. Explain the relationship between mass and weight.
3. Describe why gravity is a “Universal Force.”
4. Calculate their weight for a variety of locations in the universe.
5. Explain Newton’s Law of Universal Gravitation.
6. Create a bar graph displaying weight changes throughout the universe.

Process Objective:

Students will be able to:

1. Create hypotheses concerning the pull of gravity at other locations in universe.
2. Predict values of gravity based on objects mass.

Assessment Strategies:

1. Oral presentation on planet.
2. Weight calculations.
3. Written responses to questions
4. Graph of weight calculations.

Procedures:

1. Introduce concepts of mass, weight, and Newton’s Law of Universal Gravitation.
2. Discuss the factors that determine the force of gravity.

Suggested Level:

Intermediate/Secondary

Standard Category:

3.1 – Unifying Themes
3.4 – Physical Science, Chemistry, and Physics

Materials:

Scale

Instructional Strategies:

Discussion
Inquiry
Cooperative Learning

Related Concepts:

Hypothesizing
Predicting
Oral Communication
Written Communication
Measuring
Calculating
Graphing

3. Assign students to 10 groups for study of Mercury, Venus, Mars, Jupiter, Uranus, Neptune, Pluto, the Earth's Moon, and the Sun.
 4. Allow students to investigate the planets, Moon, and Sun, with emphasis on gravitational pull.
 5. Allow students to report their findings to the class.
 6. Distribute activity sheet and explain procedure.
 7. Allow students to measure weight on Earth, perform calculations, and create graph of weight on Earth and other locations in universe.
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How much do I weigh in Space?

An investigation to determine the relationship between the mass, gravity, and weight.

Thought questions to begin:

What impact does gravity have on weight?

How do you expect gravity changes to affect your mass? Weight?

What other observations might you make if living in an environment with more or less gravity?

Investigation:

To investigate the relationship between gravity and weight, follow the following instructions carefully:

1. Carefully weigh yourself on a scale. Record your weight. Repeat the measurement two more times. Calculate the average of these measurements.
2. Using the values indicated in the table calculate your weight at a variety of locations in the universe. Show all of your calculations in the space provided.
3. Construct a graph displaying your weight changes as you travel through the universe.
4. Respond to “questions to ponder.”

Questions to ponder:

1. Describe the relationship between mass and weight?
2. What factors determine the force of gravity?
3. Can your weight change as you travel to a variety of locations on Earth? Explain.
4. Based on your observations, where in the universe would you have the most weight? Why?
5. Which location in the universe has the most mass? How do you know?
6. Which location in the universe has the least mass? How do you know?
7. Why is gravity considered a universal force?
8. Explain Newton’s Law of Universal Gravitation.

Data Table 1: Weight on Earth in pounds

Trial 1	
Trial 2	
Trial 3	
Average	

Data Table 2: Weight at Locations in Universe

Location in Universe	Gravitational Force	Calculations	Weight (lbs)
Earth	1g		
Mercury	.39g		
Venus	.91g		
Mars	.38g		
Jupiter	2.6g		
Saturn	1.1g		
Uranus	.88g		
Neptune	1.14g		
Pluto	.05g		
Moon	.167g		
Sun	24.1g		
Microgravity (μg) in Shuttle	0.000001g		
Zero Gravity	0g		

Measuring Scientifically

Name _____ Date _____ Course/Class _____

Task/Assignment _____

Performance Criteria	Assessment			
	Points	Self	Teacher	Other(s)
1. Appropriate tools, techniques, and metric units were selected and used effectively for making measurements.				
2. Measuring techniques were practiced and refined before final measurements were recorded.				
3. Careful measurements were taken in order to minimize systematic measurement error.				
4. The set of measurements is recorded in an organized way (list, table, or chart) so that patterns in the data can easily be discerned.				
5. All measurements are clearly labeled with an appropriate magnitude (numerical value) and unit.				
6. Measurements are reported to the correct number of significant figures.				
7. Alternative strategies, techniques, and measuring tools for improving measurements were examined and discussed.				
8. Multiple measurements were repeated to insure accuracy.				

O Comments	O Goals	O Actions

Graphing Scientific Data

Name _____ Date _____ Course/Class _____

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Task/Assignment _____

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Expert 4	An appropriate type of graph was expertly used for the data set(s). The title of the graph clearly relates to the data displayed and reflects both the independent and dependent variables. Physical intervals on the graph are scaled appropriately and spaced evenly. All the parts of the graph are clearly and accurately labeled. The set of data is plotted on the graph completely and accurately and the slope of the relationship is indicated. Colors, textures, labels, or other features are used to enhance the graph.
Proficient 3	An appropriate type of graph was used for the data set(s). The title of the graph relates to the data displayed and reflects both the independent and dependent variables. Physical intervals on the graph are scaled appropriately and spaced evenly. Most parts of the graph are clearly and accurately labeled. The set of data is plotted, with only minor errors. Colors, textures, labels, or other features are used to enhance the graph.
Emergent 2	An appropriate type of graph was used for the data set(s). The title of graph relates somewhat to the data displayed, but does not reflect both the independent and dependent variables. Physical intervals on the graph are scaled appropriately and spaced evenly. Some confusion exists as to labeling the parts of the graph. The set of data is plotted, with some errors. There is minimal use of colors, textures, labels, or other features to enhance the graph.
Novice 1	An inappropriate type of graph was used for the data set(s). The title of graph vaguely relates to the data displayed and does not reflect both the independent and dependent variables. Major problems exist with labeling the axes with an appropriate sequence of numbers based upon the range of the data. Physical intervals on the graph are not scaled appropriately nor spaced evenly. Much confusion exists as to labeling the parts of the graph. The set of data is plotted, with many errors. There is little, if any, use of colors, textures, labels, or other features to enhance the graph.

☐ Comments

☐ Goals

☐ Actions